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(19)

(54) VIDEO AMPLIFIER CIRCUIT FOR TELEVISION RECEIVERS

(71) We, INDESIT INDUSTRIA ELETTRODOMESTICI ITALIANA S.P.A., an Italian Company, of Strada Piossasco km 17, Rivalta (Turin), Italy, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to video amplifier circuits for television receivers, particularly colour television receivers.

A number of video amplifier circuits are known which require a stabilized supply voltage in order to guarantee correct operation and to avoid contrast variations as a result of voltage variations of the supply network and to prevent the contrast being influenced by the information content in the picture received, particularly by the degree of colour saturation. At present, because in a colour television receiver the supply voltage of the final stages of the video amplifier is rather high, it is necessary to provide suitable stabilising circuits which complicate the supply circuits, or to derive the said voltage from the stabilized horizontal deflection circuits.

However this latter solution has the disadvantage of loading the final horizontal deflection stage, necessitating an oversizing of the transformer and the horizontal deflection stabilization circuits.

Moreover, in most conventional video amplifiers, it is necessary to provide manual control of the working point of the final transistors, so that they operate at a point which provides good dynamics for the output signal and does not dissipate excessive power. Finally, if the supply voltage of the amplifier circuits is not compensated in step with variation of the absorption of the television receiver, that is to say, variation in the degree of saturation of the colours received, and therefore of the intensity of the beam currents of the three electron guns, unpleasant variations in contrast occur as and when the reproduced scene changes.

In any case, all these devices, apart from complicating the circuits, give rise to additional costs and a consequent increase in the price of color television receivers.

The object of the present invention is to provide a video amplifier circuit which avoids the above-mentioned disadvantages.

According to the present invention there is provided a video amplifier circuit for a television receiver, comprising at least two video amplifiers, each containing at least one semiconductor device having at least two electrodes and fed by a source of non-stabilized supply voltage, in which there is provided first means which sample the bias voltage of at least one said electrode and provide a single signal representative of the bias voltages of said semiconductor devices of both or all said video amplifiers, second means which receive the said representative signal and generate a control signal which is a function of the biasing of the said electrodes, and third means which transmit the said control signal to the said semiconductor devices for the purpose of maintaining the stability of operation of the latter.

The invention will now be described, by way of non-limiting example, with reference to the appended drawing, which shows an electrical schematic diagram of one embodiment of the invention.

The drawing shows the final stage of a video amplifier for a colour television set, comprising three amplification stages which are intended to supply the three primary colour signals designated R (red), G (green) and B (blue), to the corresponding three cathodes of a picture tube (not shown). In the example shown, each amplification stage fulfils the dual function of an amplifier and a summator of a luminance signal and a respective colour difference signal.

In the drawing, 1, 2 and 3 indicate three input terminals to which three colour difference signals, R—Y, G—Y and B—Y, are supplied. These difference signals must be added to the luminance signal Y and amplified before being passed to the picture

tube. The difference signals are supplied to three transistors 4, 5 and 6, which constitute the active elements of the respective video ampifiers. The three transistors 4, 5 and 6 are identical and so are the electrical networks connecting them, therefore only one of these three transistor amplifier circuits, for amplifying the R—Y difference signal, will be described.

The difference signal R—Y present at the terminal 1 is applied to the base of the NPN transistor 4 through a resistor 7 and an inductance 8 in series. The base of the transistor 4 is connected to earth through a capacitor 9. The collector of the transistor 4 is connected to a supply source of voltage $+V_1$ through a resistor 10 and an inductance 11 in series. To the collector of the transistor 4 there is also connected one end of a parallel RL network, constituted by a resistor 12 and an industance 13, the other end of the network RL constituting the output terminal of the video amplifier. To the emitter of the transistor 4 is connected one end of a first electrical RC network constituted by a resistor 14 having in parallel, through a capacitor 15, a potentiometer 16 and a capacitor 17. Between the end of the potentiometer 16 connected to the capacitor 15 and the cursor of the potentiometer 16 there is connected a second parallel RC network constituted by a resistor 18 and a capacitor 19.

The components of the electrical network associated with the transistor 5 of the amplifier circuit for the difference signal G—Y correspond to those of the circuit for the R—Y signal just described, and are indicated by the same reference numerals, increased by 20, while corresponding components of the electrical network associated with the transistor 6 of the B—Y amplifier circuit are indicated by the same reference numerals increased by 40.

The emitters of the three transistors 4, 5 and 6 are connected, through the respective resistors 14, 34 and 54 to the emitter of a PNP transistor 60. The emitter of the transistor 60 is also connected to a supply source of voltage $+V_2$ through a resistor 61 whilst the collector of the transistor 60 is earthed. The base of the transistor 60 is connected to the collector of an NPN transistor 62 through a resistor 63. The collector of the transistor 62 is connected to the supply voltage $+V_2$ through a resistor 64 whilst its emitter is connected to earth. The luminance signal Y is applied to the base of the transistor 62 through a resistor 65. The base of transistor 62 is also connected to earth through a resistance 66, to the emitter of the transistor 60 through a resistor 67 in series with an LC network constituted by a resistor 68 and an inductance 69 in parallel, and finally to the emitter of an NPN transistor 70 through a resistor 71.

The emitter of the transistor 70 is connected to earth through a resistor 72, whilst the collector of transistor 70 is connected to the supply voltage $+V_2$. The base of the transistor 70 is connected to earth through a resistor 73 and a capacitor 74 in parallel and to the cathode of a diode 75 through a resistor 76. Fly-back pulses are applied to the cathode of the diode 75 through a resistor 77 and a capacitor 78 in series, these pulses being picked up in the conventional manner from the line deflection circuits.

The anode of the diode 75 is connected to the collector of a PNP transistor 79. The emitter of the transistor 79 is connected to the supply voltage $+V_2$ through a resistance 80, whilst its base is connected to earth through a resistor 81 and to the collector of an NPN transistor 82, through a resistor 83.

The emitter of the transistor 82 is connected directly to the supply voltage $+V_2$, and its collector is connected to a supply voltage $+V_3$ through a resistor 84, its base being connected to earth through a resistor 85 and to the collector of the same transistor through a resistor 86. To the base of the transistor 82 there is applied, through resistors 87, 88 and 89, three respective primary colour signals R, G and B which are picked up through a divider (not shown in the drawing) from the output terminals of the aforementioned three final video amplifiers 4, 5 and 6.

The operation of the circuit is as follows.

The transistor 82, with its associated components, functions as a threshold circuit; in fact, the transistor 82 is so biased that it is normally switched off. The transistor 82 becomes conductive only when the signal present at its base exceeds a predetermined threshold level, specifically when the voltage present at the network formed by the three resistors 87, 88 and 89 is at its maximum value: this occurs during the scan flyback periods when the matrix is supplied with the three primary colour signals taken from the cathode circuit of the picture tube.

It should be noted that because of the negative feedback provided through the resistor 86 it is not necessary that the supply voltage $+V_3$ should be highly stabilized in order to obtain a satisfactory operation of the circuit when the mains voltage, the current consumed by the television receiver or the temperature vary.

The voltage present at the collector of the transistor 82 is transferred through the resistor 83 to the base of the transistor 79. The latter, in conjunction with the diode 75, the capacitor 78 and the resistor 77 to which the fly-back pulses are applied, acts as a comparator gate circuit, its output comprising a voltage which is a function of the

voltage amplitude present on the base during the sampling periods, and therefore a function of the amplitude of the RGB signals. It should be noted that since the transistor 82 conducts only during the flyback periods, the output voltage of the said comparator gate circuit is independent of the information content present in the video signal, that is to say it depends only on the value of the extinction voltage of the RGB signals.

A low-pass smoothing filter comprising the capacitor 74 and resistors 73 and 76 is connected to the output of the comparator circuit constituted by the transistor 79, the filter acting as a storage network. At the output of the smoothing filter there is available a substantially direct current signal the voltage of which is a function of the maximum amplitude of the three RGB signals, corresponding to the extinction voltages of the cathodes and to the so-called ultra-black level, which can be used for controlling the working point and the gain of the three transistors which constitute the final three video amplifiers. This voltage, together with the luminance signal Y, is amplified in the luminance signal amplifier formed by the transistors 62 and 60 coupled in tandem, and is passed to the emitters of the three transistors 4, 5 and 6 to control their bias.

Therefore, the bias of the three transistors 4, 5 and 6 is not fixed, but is variable as a function of the unstabilised supply voltage $+V_1$, the intensity of the beam current, the characteristics of the transistors and the operating temperature of the circuit. The variation of the D.C. bias voltage applied to the emitters of the transistors 4, 5 and 6 tends therefore to make the levels of the signals supplied to the cathodes of the picture tube independent of any variation in the above factors. All this is achieved on condition that the voltages present at the collectors of the transistors 4, 5 and 6 have predetermined values during the scan flyback periods. To ensure that a negative feedback loop is provided, consisting of the threshold circuit, the comparator circuit and the luminance amplifier, which samples the cut-off voltages of the three cathodes and effects a comparison with a fixed voltage to generate an error signal which causes the consequent variation of the bias of the final video amplifier transistors. It should be noted that in the circuit described, only the voltage $+V_2$, which serves as a reference voltage, is stabilized.

From the preceding description the advantages of the present invention are evident. In particular the possibility of supplying the final video amplifier transistors directly with rectified non-stabilized mains voltage, which can show variations of $\pm 15\%$ relatively to the nominal voltage, without causing appreciable variations of the contrast or the tint. The working point of the final video amplifier transistors is automatically fixed, thus eliminating the need for manual control. The cut-off voltage level of the cathodes is automatically fixed and moreover occurs independently of the voltage which controls the final stage. Furthermore, the thermal stability of the circuit is, within wide limits, independent of variations of either the active or passive components. Finally, the matrixing of the colour difference signals with the luminance signal, effected in the base-emitter junctions of the final video amplifier transistors, allows a considerable economy in components.

A further reduction in the number of components can also be obtained by using a single control circuit for the biasing of the three final video amplifier stages, this being possible only by virtue of the principle of sampling the value of the voltage applied to the cathodes in the flyback periods, that is to say, at a time when the video signal is not affected by the transmitted information, and controlling the biasing voltage as a function of this sampled voltage.

It will be appreciated that the example described relates to a video amplifier circuit for a colour television receiver, but it is clear that other practical applications of the invention can be evolved without departing from the scope of the present invention.

A list of the circuit components and their values and type designations is given below, with reference to the embodiment of the invention illustrated in the drawing, each component being indicated by the corresponding reference numeral employed in the drawing.

Circuit Components

Resistors		Capacitors	
7	47 Ohm	9	330 pF
10	6.8 Kohm	15	47 μF
12	10 Kohm	17	820 pF
14	150 Ohm	19	330 pF
18	390 Ohm	29	330 pF
27	47 Ohm	35	47 μF
30	6.8 Kohm	37	820 pF
32	10 Kohm	39	330 pF
34	150 Ohm	49	330 pF
38	390 Ohm	55	47 μF
47	47 Ohm	57	820 pF
50	6.8 Kohm	59	330 pF
52	10 Kohm	74	1 μF
54	150 Ohm	78	0.1 μF
58	390 Ohm	Inductances	
61	1 Kohm	8	100 μH
63	47 Ohm	11	36 μH
64	1 Kohm	13	110 μH
65	1.2 Kohm	28	100 μH
66	220 Ohm	31	36 μH
67	1.5 Kohm	33	110 μH
68	1 Kohm	48	100 μH
71	1.5 Kohm	51	36 μH

72	470 Ohm	53	110 μH	
73	10 Kohm	69	47 μH	
76	22 Kohm	Potentiometers		
77	100 Ohm	16	1 Kohm	
80	220 Ohm	36	1 Kohm	
81	3.3 Kohm	56	1 Kohm	
		Transistor Types		
83	2.2 Kohm	4	BF 458	
84	1.5 Kohm	5	BF 458	
85	22 Kohm	6	BF 458	
86	10 Kohm	60	BC 328	
87	10 Kohm	62	BC 148B	
88	10 Kohm	70	BC 148B	
89	10 Kohm	79	BC 157	
Supply Voltages		82	BC 148B	
$+V_1=250$ V				
$+V_2=12.5$ V		Diode		
$+V_3=30$ V		75	1N 4148	

WHAT WE CLAIM IS:—

1. A video amplifier circuit for a television receiver, comprising at least two video amplifiers, each containing at least one semiconductor device having at least two electrodes and fed by a source of non-stabilized supply voltage, in which there is provided first means which sample the bias voltage of at least one said electrode and provide a single signal representative of the bias voltages of said semiconductor devices of both or all said video amplifiers, second means which receive the said representative signal and generate a control signal which is a function of the biasing of the said electrodes, and third means which transmit the said control signal to the said semiconductor devices for the purpose of maintaining the stability of operation of the latter.

2. A circuit according to Claim 1, in which the said first means comprise a threshold circuit defining a threshold which is exceeded during scan flyback periods.

3. A circuit according to Claim 2, in which the said threshold circuit comprises a transistor which is normally biased to cut off and which receives at its control electrode a combination of the video signals present at the output of the said amplifier.

4. A circuit according to Claim 3, in which the said representative signal is available at the output electrode of the said threshold circuit transistor.

5. A circuit according to any one of the preceding Claims in which the said second means compare the said representative signal during the scan flyback periods with a fixed reference and in that the control signal produced by said second means is stored.

6. A circuit according to Claim 5, in which the said second means comprise a second transistor periodically activated by the return pulse drawn from the horizontal deflection circuits, at the input terminals of which are applied the said representative signal from the said first means and the said fixed reference signal.

7. A circuit according to Claims 5 or 6, in which the control signal is stored in a low pass filter.

8. A circuit according to any one of the preceding claims in a colour television receiver including a luminance signal amplifier, in which the said third means include an amplifier which amplifies both the luminance signal and the control signal, the output of said amplifier being applied to the said video amplifier semiconductor devices for the purpose of controlling the bias of the said devices.

9. A circuit according to any one of the preceding claims in which each of the said video amplifiers receives the same said control signal.

10. A circuit according to Claim 8 or 9, in which each of the said semiconductor devices comprises a transistor to the base of which is applied, in use of the circuit a colour difference signal, the luminance signal and the said control signal being applied to the emitters of said transistors, and primary colour signals being provided at the collectors of said transistors.

11. A circuit according to Claim 10, in which the bias voltage of at least one collector of the said transistors is sampled.

12. A video amplifier circuit for a television receiver substantially as herein described with reference to and as shown in the accompanying drawings.

PAGE, WHITE & FARRER,
Chartered Patent Agents,
27 Chancery Lane,
London WC2A 1NT.
Agents for the Applicants.

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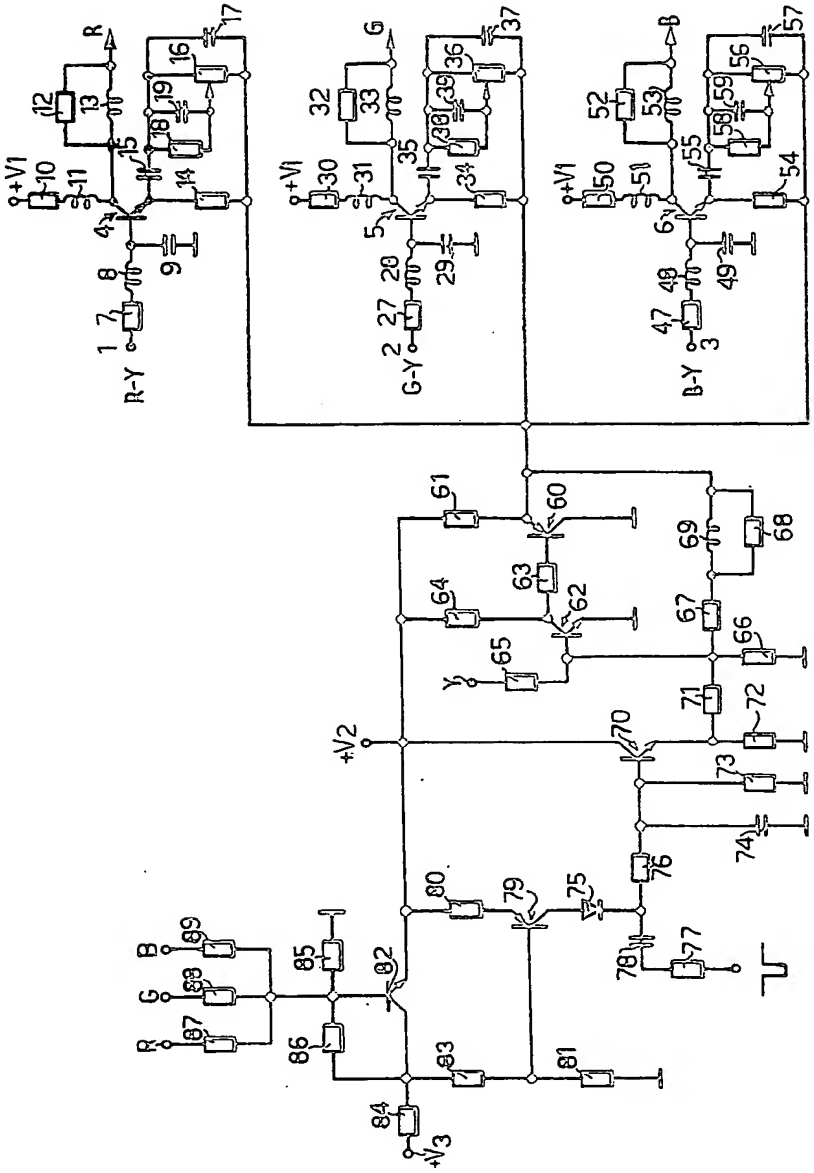
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*



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